REMARKS/ARGUMENTS

Claims 1, 4-11 and 20 are pending in this application. Claims 2, 3 and 12 are canceled. Claims 1, 4, 8 and 20 have been amended. Claims 13-19 have been withdrawn.

Claims 5 and 10 were rejected for lack of support in the specification. Claims 5 and 10 are original claims and, therefore, they form part of the disclosure as filed. To provide support in the specification, the objected-to language of claim 5 (which closely tracks the language of claim 10) was added to paragraph [0023] to overcome this rejection of claims 5 and 10.

Further, the dependency of claim 4 has been corrected, and the objected-to terms "exchanging heat" in claim 4 and "adding oxygen" in claim 8 have been revised to employ the corresponding language of claim 1.

In view thereof, applicant requests that the Section 112 rejection of claims 4, 5, 8 and 10, as well as the objection to the specification (for failing to provide support for claims 5 and 10), be retracted.

Substantively, claims 1, 4-8 and 20 were rejected for anticipation by Woods (US 2002/0006535). Part of this rejection is the Examiner's notation that it is inherent "that transferring heat from the anode exhaust gas to the cathode exhaust gas prior to forming the mixture would result in lower peak temperatures that develop during forming the mixture". Applicant has carefully considered this observation, but does not understand its relevance because the application does not describe and the claims do not require a heat transfer from the anode gas to the cathode gas. Should this notation be further relied on, applicant requests an explanation how it relates to the claims so that he can address it.

Claims 9-11 were rejected for obviousness over Woods in view of Haltiner (US 2003/0235733). Woods was applied in the same way as it was applied against claim 1, and Haltiner was relied upon as teaching to flow an effluent from a catalytic oxidizer to the fuel cell.

The present invention concerns the operation of a fuel cell 8 in which anode gas from the anode side 4 of the cell flows through an inlet 10 into a heat exchanger 14. Downstream of the heat exchanger is a mixing space 26 where the anode gas is mixed with air and the resulting mixture is fed to a catalytic reactor 28 where the combustible components of the anode gas are oxidized, thereby heating the air-anode gas mixture. From the catalytic converter, the anode gas-air mixture flows as an effluent through return conduit 32 to the fuel cell. (Paragraph [0019]).

The anode gas normally exits the fuel cell at a high temperature of about 1200°-1300° F. "Such high temperature anode gas if mixed immediately with air can form pockets in the mixture that can lead to the earlier mentioned, undesirable auto-ignition of portions of the mixture." (Paragraph [0011]). To prevent such auto-ignition, the anode gas is initially passed through a heat exchanger 14 where some of its heat is transferred to the air before the anode gas and air are combined to form the above-mentioned air-anode gas mixture. Only thereafter is the anode gas mixed with the air "so that the peak temperature in the mixing zone [26] is below the auto-ignition temperature of the fuel components ...." (Paragraph [0009]).

Thus, the present invention is directed to only a portion of a fuel cell plant and deals with the effective and safe liberation of chemical energy from the fuel components in the fuel cell anode gas to raise the temperature of the anode gas-air mixture and, to the extent needed, to further raise the temperature of the mixture. Energy supplied by supplemental fuel is combined as needed with the energy of the physical heat of the anode gas in a common (single) flow and takes place in the catalytic oxidizer. The energy contained in such a single flow can be conveniently controlled and utilized in connection with a fuel cell generating electrical power.

Independent claim 1 requires in part "transferring heat from the anode gas to the air before the air is added to the anode gas to thereby lower a temperature of the anode gas ...."

Independent claim 20 similarly recites "exchanging heat between the air and the anode gas prior to forming the mixture to thereby lower local peak temperatures developing during forming the mixture".

Both independent claims were rejected for anticipation by Woods, which discloses an integrated power module in which a reformer 116, a fuel cell 118 and a combustor 120 are stacked one on top of the other and surrounded by an annular volume 114 through which inlet air 112 flows. The inlet air is mixed with fuel 156 and fed to reformer 116. (Paragraph [0024]). "Reformer product gases then pass out of the reformer 116 and into passage 168 and thereby heat the heat exchange wall 172 ...." (Paragraph [0025]). "The partially-cooled reformer product gas stream flows from passage 168 into the anode manifold of the fuel cell through channel 190 ... positioned between the fuel cell 118 and the reformer 116." (Paragraph [0026]).

Woods continues as follows:

> The anode exhaust gas from the fuel cell 118 [is] passed to combustor 120 through exit passage 134 .... The cathode exhaust gas will exit the fuel cell 118 and be passed also to combustor 120, but through a conduit 129 (shown in FIG. 4B) .... (paragraph [0041])
>
> Within the combustor 120, depleted air from port(s) 140 and depleted fuel from perforated surface element 14 react and combust to liberate heat, which can be recovered by a downstream user or appliance through a heat transfer coil 142. For example, the thermal energy recovered in this manner can be used to heat water that is then circulated through a residence or workplace to provide either hot water or heat, as needed. Finally, exhaust gas 144 exits the integrated power module through exhaust duct 141. (paragraph [0042])

Thus, in Woods, anode gas from fuel cell 118 flows via conduit 129 into combustor 120, where any fuel in the anode gas is combusted and heat therefrom is recovered by a recovery device, such as a heat transferring coil 142, while the gas itself is discharged and not further used.

"A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros. v. Union Oil of California*, 814 F.2d 628, 631; 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). Thus, for anticipation the "identical invention must be shown in as complete detail as is contained in the ...

claim". *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236; 9 USPQ2d 1913, 1920 (Fed. Circ. 1989). MPEP §2131.

Claim 1 requires "transferring heat from the anode gas to the air before the air is added to the anode gas to thereby lower a temperature of the anode gas ...." (emphasis added). In Woods, the anode gas flows from the anode cell of fuel cell 118 to combustor 120, where it is combined with cathode exhaust gas that enters the combustor through conduits 129. Optionally, the anode gas can be combined with additional air entering through conduit 138 to mix with the gas from conduit 129, and/or fuel added through conduit 136 mixed with the anode gas entering from exit passage 134. (Paragraphs [0041], [0044]).

In Woods, there is no heat transfer between the anode gas (or, for that matter, the cathode gas) and incoming air 138 before the air and the gas(es) are mixed. Claims 1 and 20 require heat transfer from the anode gas to the air before the two are mixed. This is not disclosed (or in any form suggested) by Woods.

For at least this reason, claims 1 and 9 are not anticipated by Woods.

Claims 1 and 20 further require "flowing the effluent to the fuel cell", the effluent being the output of the catalytic oxidizer where the anode gas-air mixture is catalytically oxidized to raise the temperature of the mixture to where the combustible components therein catalytically oxidize. In Woods, the effluent from combustor 120 is never returned to the fuel cell. Instead, it is used to power heat transfer coil 142 and, thereafter, the effluent is discharged.

For at least this further reason, claims 1 and 20 are not anticipated by Woods.

Still further, claims 1 and 20 require "heating the effluent during at least portions of the time when the fuel cell generates electricity". In Woods, physical heat is withdrawn from the effluent 144 by heat transfer coil 142, and the effluent is then discharged. It is never heated, as required by claims 1 and 20.

For at least this further reason, claims 1 and 20 are not anticipated by Woods.

Claims 1 and 9 additionally require "adding air to the anode gas to form an oxidizable anode gas mixture". Woods discloses a portion of the inlet air 112, which flows through annular space 114, "is diverted through orifice 128 to provide oxygen to the cathode manifold of the fuel cell 118". (Paragraph [0020]). Cathode air is not anode gas. Cathode air is supplied to the cathode side of the fuel cell to provide the oxygen needed by the fuel cell. Anode gas, on the other hand, is a hot gas of about 1500° F (paragraph [0027]) and contains combustible materials which are oxidized in the combustor 120.

Woods does not add air to the anode gas.

For at least this additional reason, claims 1 and 20 are not anticipated by Woods.

Thus, independent claims 1 and 20, and therewith claims 4-8 which depend from claim 1, are not anticipated by Woods.

Claims 9-11 were rejected for obviousness over Woods in view of Haltiner.

Woods was applied to claim 9 in precisely the same manner as it was applied against independent claims 1 and 20. It was recognized that Woods does not teach flowing the effluent from the catalytic oxidizer to the fuel cell, and Haltiner was relied upon as disclosing flowing the effluent 115 from afterburner 66 to a manifold surrounding stacks 44 and 46. In view thereof, it was held to be obvious to one of ordinary skill in the art to modify Woods' method of operating a fuel cell by including "flowing an effluent from the catalytic oxidizer to the fuel cell in order to more efficiently utilize the heat generated by the combustor ...."

Initially applicant points out that the four reasons discussed above why Woods does not anticipate claims 1 and 20 apply equally to claim 9. Each of the four elements of claims 1 and 20 discussed above are present in claim 9. Haltiner does not supply what is missing from Woods with regard to claims 1 and 20. This equally applies to claim 9. For at least these four reasons, claim 9 is not obvious even when Woods is combined with Haltiner.

Applicant acknowledges that Haltiner discloses (in paragraph [0039]) to flow anode gas via afterburner 66 and heat exchangers back to the fuel cells.

However, Haltiner does not disclose or suggest to flow the anode gas through a heat exchanger where the gas heats incoming air and, "thereafter mixing the cooled anode gas and the air flow downstream of the flow paths to form a mixture" (emphasis added) as required by claim 9.

Thus, Haltiner does not disclose or suggest transferring heat from the anode gas to the air flow. In Haltiner, the anode gas 110 is directly combined with air 64 and burned without initially going through a heat exchanger in which the anode gas is cooled down and the incoming air is heated up. Transferring heat from the anode gas to the incoming air before the two are mixed is important, however, because, as stated in paragraph [0005] of this application:

> The composition and temperature of anode gas from fuel cells can vary over wide ranges during normal operation of the fuel cell. When mixed with air, the mixture is not immediately homogeneous. Instead, portions of the anode gas form flammable and not flammable pockets of micro mixtures. The temperature of such pockets of flammable mixture can rise above the auto-ignition temperature of the combustible components, which can lead to instantaneous micro explosions creating rapid pressure pulsations, and/or combustion instabilities, all of which are detrimental to the equipment, including the fuel cell. Controlling the flammability conditions during the mixing process is complicated by the fact that changes in the composition and flow of the anode gas can be abrupt, for example, when there are sudden changes in the power demand placed on the fuel cell.

The present application further describes how the formation of such auto-ignitable pockets in the flammable mixture are avoided:

> The temperature of the anode gas can be as high as about 1200°-1300° F ... or more, a temperature that may be above the auto-ignition temperature of the combustible components in the gas. Such high temperature anode gas if mixed immediately with air can form pockets in the mixture that can lead to the earlier mentioned, undesirable auto-ignition of portions of the mixture. The amount of air passing through the heat exchanger is typically several times more than the flow of anode gas, and the initial temperature of the air is as low as ambient temperature. As a result, the average bulk mixed temperature as well as peak temperature of the flow downstream of the heat exchanger are always well below

> the auto-ignition temperature of about 800°-1000° F ....
> (paragraph [0011])

There is no recognition in Haltiner of the problems created by flammable micro pockets in the mixture flow. Anode gas is directly mixed with air in afterburner 66, and the formation of flammable micro pockets in the mixture is not prevented by Haltiner.

Thus, disregarding arguendo the fact that Woods does not disclose or suggest the above-mentioned four features recited in claim 9, which are also present in claims 1 and 20, when Woods is combined with Haltiner the resulting combination does not transfer heat from the anode gas to the air flow before the two are mixed, as required by claim 9. Haltiner therefore does not eliminate the problems associated with flammable micro pockets, while the transfer of heat from the anode gas to the air flow required by claim 9 prevents the formation of such micro pockets.

One of ordinary skill in the art would be clueless from reading Woods and/or Haltiner of the benefits attained when transferring heat from the anode gas to the air before the two are mixed. As a result, one of ordinary skill in the art would not find it obvious to go to the added trouble of initially transferring heat from the anode gas to the incoming air and incurring the added expense resulting therefrom, because there is no guidance in the prior art why this should be done, and one of ordinary skill in the art would have no other reason of his own for doing so.

Thus, independent claim 9 is not obvious over Woods and Haltiner because of the deficiencies in the disclosures of Woods and Haltiner discussed here as well as earlier in connection with claims 1 and 20.

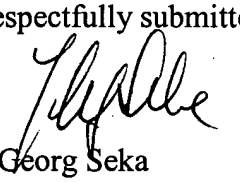
Claims 10 and 11, which depend from claim 9, are directed to specific features of the present invention which are independently patentable. These claims are further allowable because they depend from allowable parent claim 9.

CONCLUSION

In view of the foregoing, applicant submits that this application is in condition for allowance, and a corresponding notification at an early date is requested.

If the Examiner believes a telephone conference would expedite prosecution of this application, please telephone the undersigned at (415) 273-4730 (direct dial).

Respectfully submitted,



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